

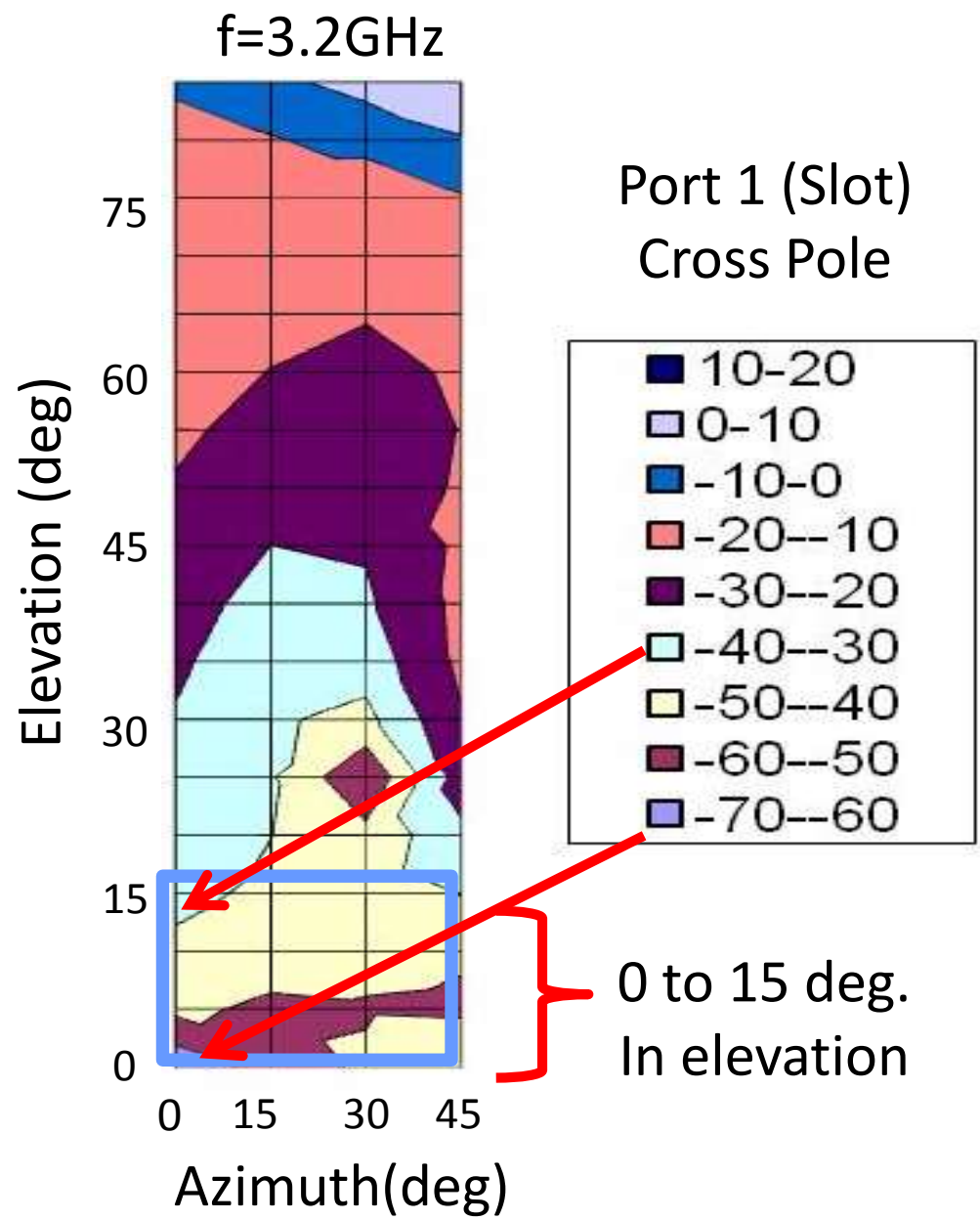
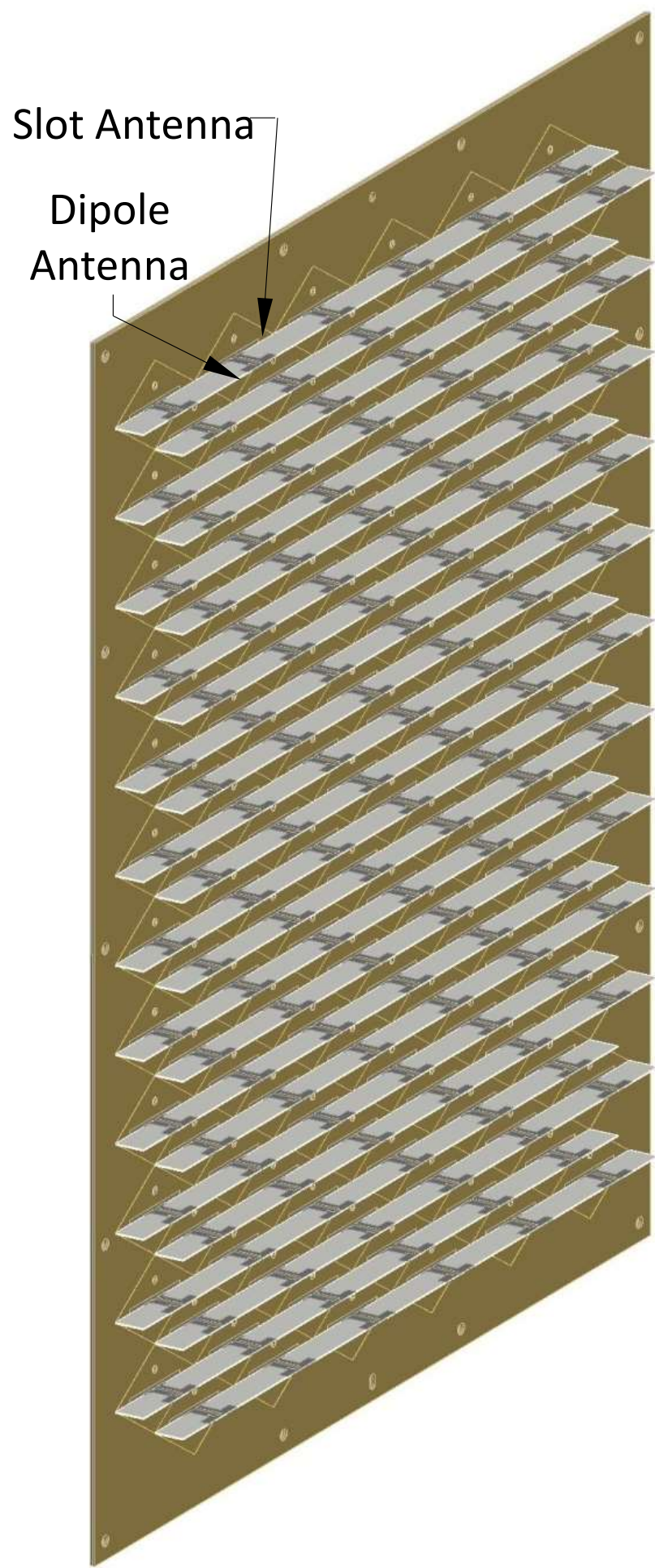
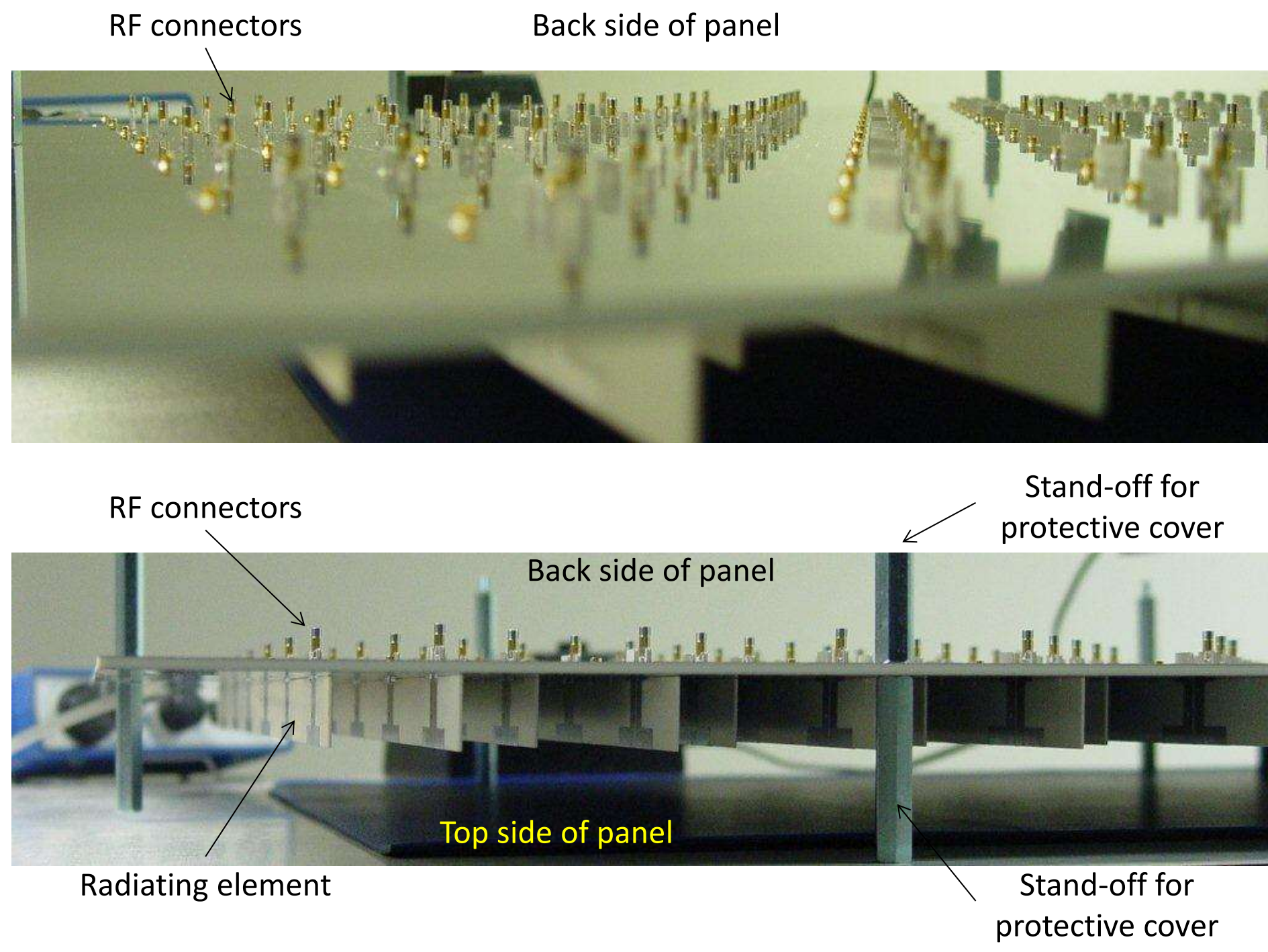
# Dual Polarized Slot Dipole Radiating Element Performance

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## Abstract

One of the challenges in developing polarimetric phased array antennas for weather applications is the radiating element's cross pol performance over the scan volume. This poster will present a slot-dipole dual polarized radiating element design and performance. A panel of 144 dual pol elements was fabricated and characterized in the far field RF anechoic chamber to demonstrate cross pol performance across the operating S-band frequency and scan volume. An interactive simulation was developed to extrapolate the measured slot-dipole element performance and demonstrate the panel co-pol and cross-pol patterns for any azimuth and elevation angles. The test results of the first iteration of the dual pol element have demonstrated promising performance and future recommendations to enhance element performance are identified.



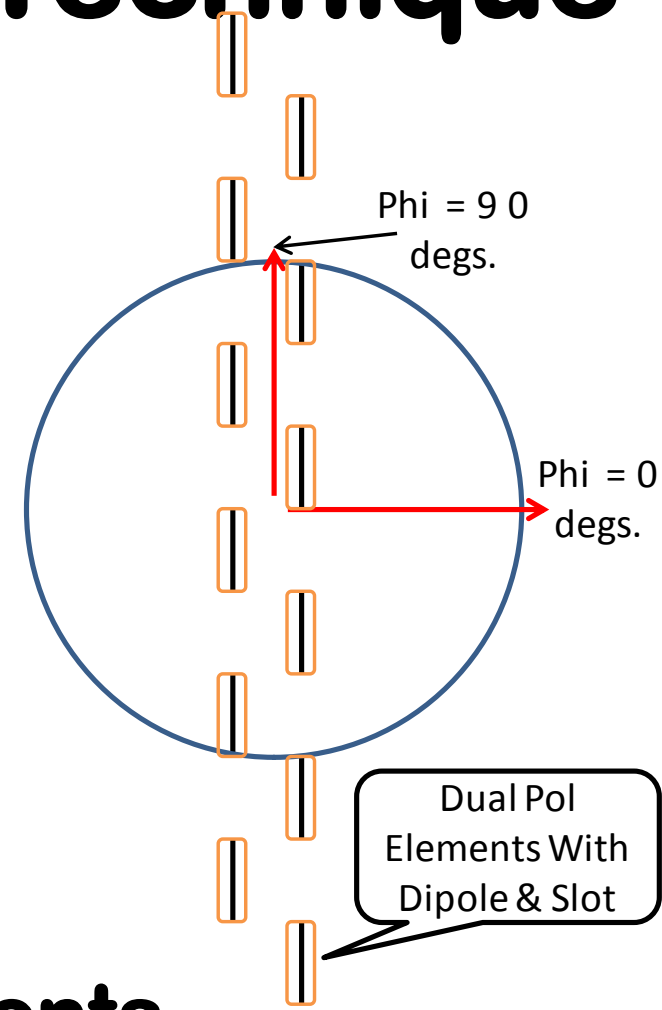
Very good performance over scan volume

## Goal / Motivation

- Goal – develop a passive dual pol antenna radiating element panel to maximize cross pol isolation at S-band (3.1 to 3.3 GHz)
- Solution – make use of a slot dipol radiating element that addresses off-axis orthogonality over the desired scan volume
- Testing – design the panel for 144 elements (12 x 12) so that in test, the center element will appear to be in an infinite array simulating a large antenna. Use measurements to validate models.
- Construction – design into a 3 metal layer laminate structure for light weight, low cost

## Measurement Technique

- Measure from 3.1 GHz – 3.3 GHz in 100 MHz steps
- Mechanically scan in phi and theta
- All unused elements terminated in 50 ohms



### Column Measurements

- A center column of 12 uniformly illuminated elements which are set in a triangular lattice
- 12:1 Coax power divider used to illuminate the center column
- Co-pol and cross-pol patterns for the dipoles and the slots measured independently

### Element Measurements

- A single dual polarized element, located in the center of the sub-array was used for these measurements
- Center element was excited one polarization at the time
- Co-pol and cross-pol measurements were made for the for both dipole and the slot

## Cross-Pol Characteristics

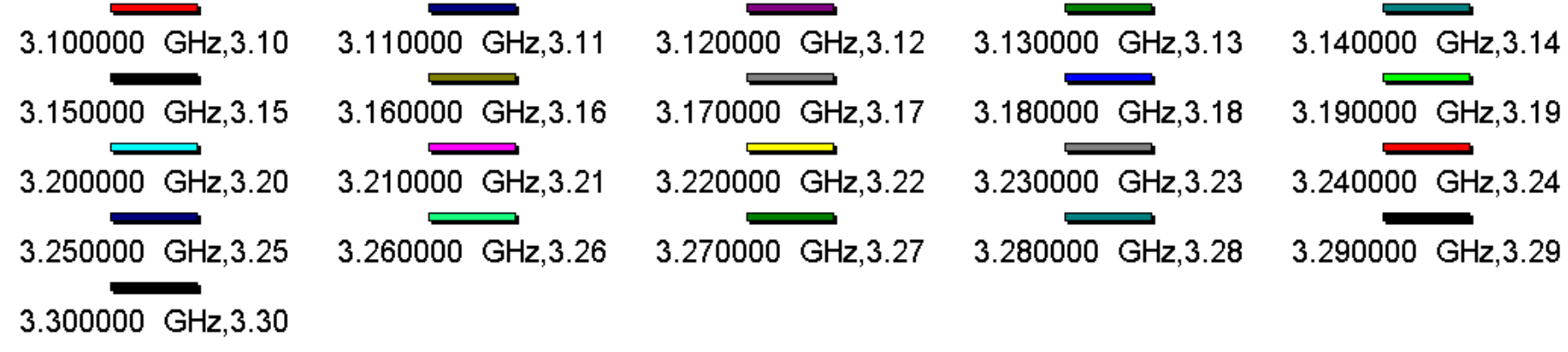
Cross Pol Level (dB)		
Phi Cut	Dipol	Slot
Phi = 0 Degs.	-43	-42
Phi = 22 Degs.	-34	-34
Phi = 45 Degs.	-29	-30
Phi = 68 Degs.	-42	-39
Phi = 90 Degs.	-44	-40

- For each Phi cut the polarization of the receive horn is adjusted to align with the dipole.
- This produces the co-pol pattern horn alignment.
- The cross-pol patterns were taken with receive horn perpendicular to the adjusted co-pol angle.

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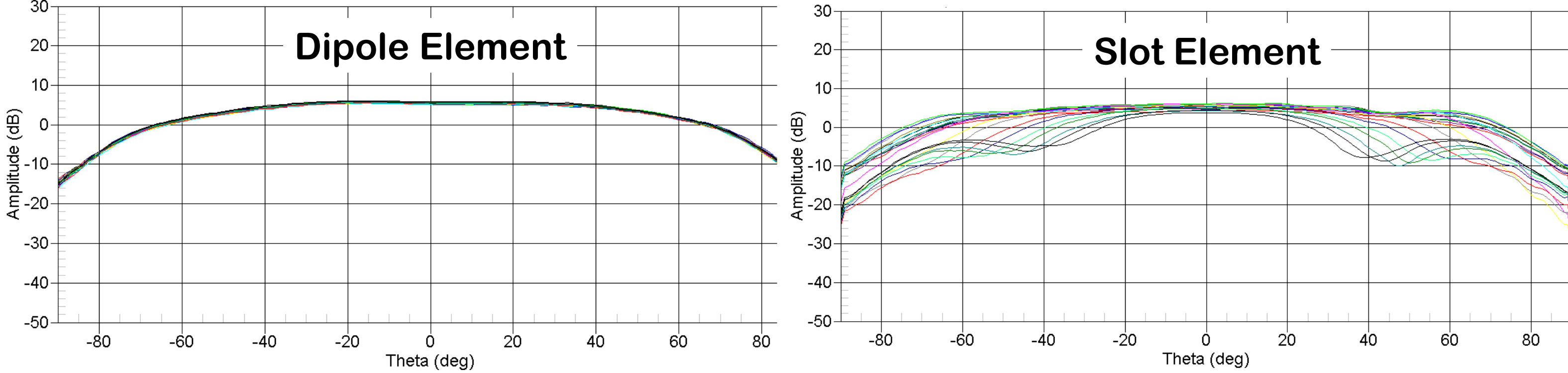
## Element Patterns

- Measured on single element, located in the center of the array.
- Co-pol and Cross-pol measurements were made for the for both dipole and the slot.
- Measurements were made with Phi = 0 (in a plane perpendicular to the dipole & slot)



Measured across the frequency band from 3.1 GHz to 3.3 GHz in steps of 100 MHz

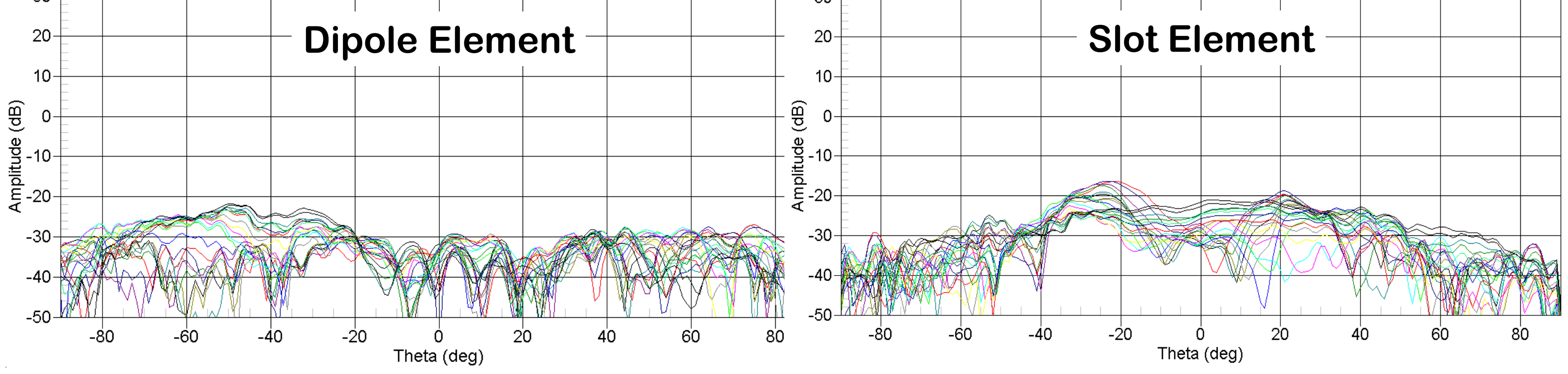
### Co-Pol Far Field Amplitude



Symmetrical patterns that track over the complete frequency band. They are consistent with a dipole in the orthogonal plane

Symmetrical patterns but do not track over the frequency band.

### Cross-Pol Far Field Amplitude

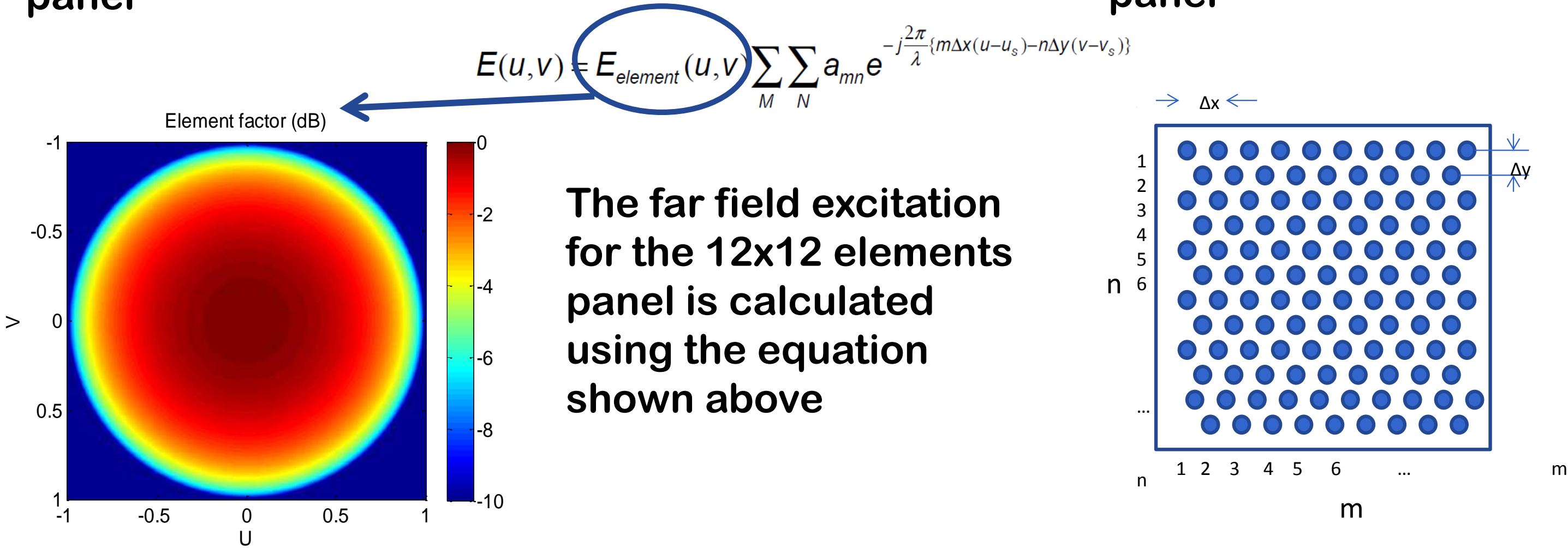


Highly random single element cross-pol signals with frequency and scan angle which will lead to significant reduction of cross-pol signal level with a full array

## Measured Element Post Processing Analysis to Full Array

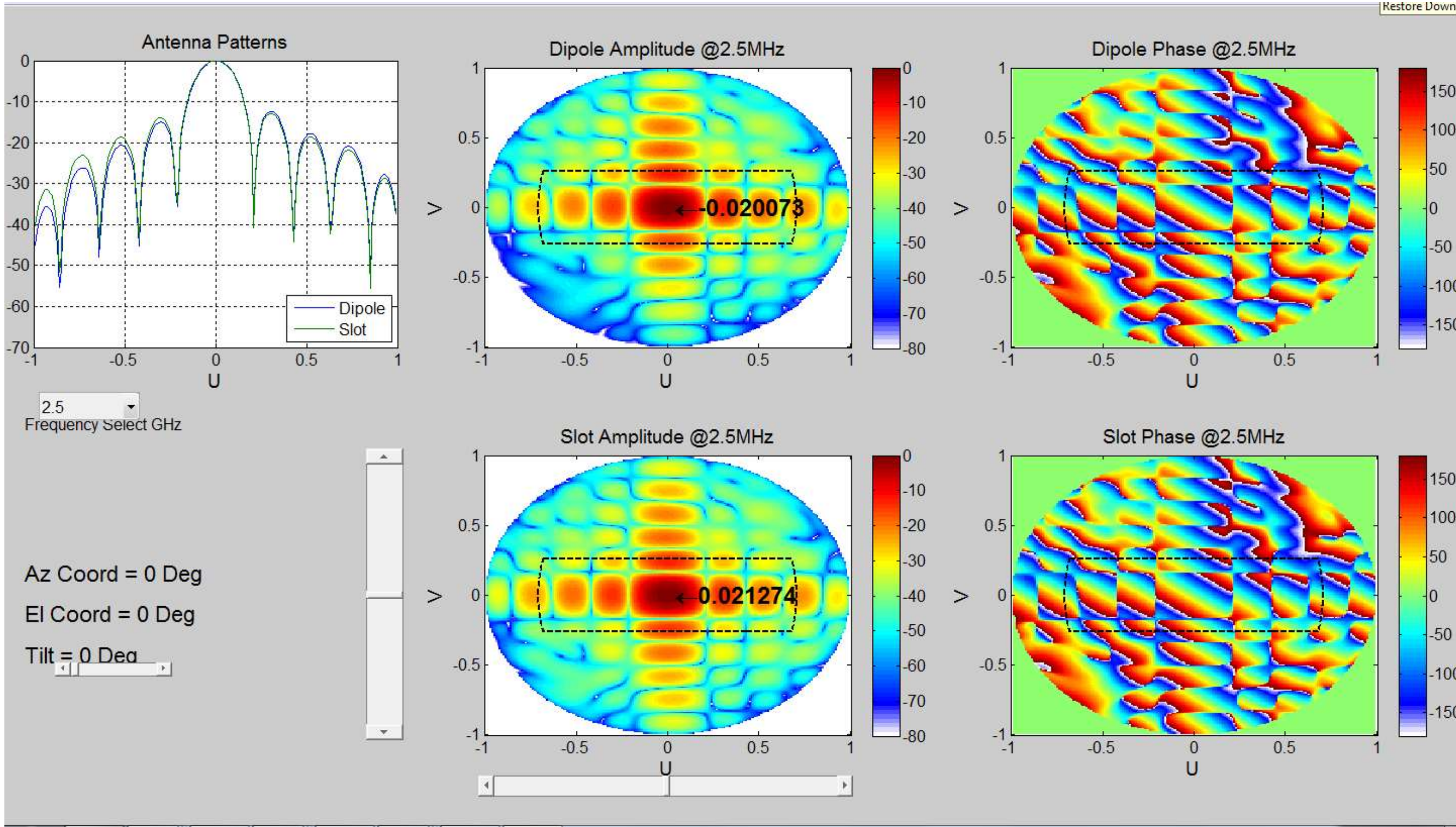
The element factor was measured in its far field and the data was used in the extrapolation to the full panel

The array factor was calculated assuming a uniform illumination of the 144 elements in the panel



The far field excitation for the 12x12 elements panel is calculated using the equation shown above

Simulation tool calculates and displays antenna patterns, dipole and slot amplitudes and phases. Can vary frequency, azimuth, elevation and array tilt through the use of the slider bars. See live demo.



## Conclusion

- First iteration of the 12x12 Slot Dipole radiating element panel demonstrated good performance
- Expanding the radiating element cross-pol to full size MPAR will further enhance performance
- Error from RF reflections and test equipment (standard gain horn, source, and receiver) contributed to characterization of the panel
- Future iteration is required to optimize slot performance at wide scan angles and across the 300MHz band

## Acknowledgment

The author wishes to thank the National Severe Storms Laboratory for funding the development and testing of the slot dipol antenna panel and Basic Commerce & Industries, Inc., the prime contractor for the project.